AF (2yw

TRANSMITTAL OF APPEAL BRIEF (Large Entity)

Docket No. 200-1451

In Re Application Of: **Paul Joseph Stewart et al.**

Application No.	Filing Date	Examiner	Customer No.	Group Art Unit	Confirmation No.
09/775,368	February 1, 2001	A. Nelson	33481	2675	8120

Invention: **SYSTEM AND METHOD OF INTERACTIVE EVALUATION OF A GEOMETRIC MODEL**

OIPE JUN 3 0 2005 JC32 PATENT & TRADEMARK OFFICE

COMMISSIONER FOR PATENTS:

Transmitted herewith in triplicate is the Appeal Brief in this application, with respect to the Notice of Appeal filed on

The fee for filing this Appeal Brief is: **$500.00**

☐ A check in the amount of the fee is enclosed.

☐ The Director has already been authorized to charge fees in this application to a Deposit Account.

☒ The Director is hereby authorized to charge any fees which may be required, or credit any overpayment to Deposit Account No. **06-1510**

☐ Payment by credit card. Form PTO-2038 is attached.

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

Signature

Dated: June 27, 2005

Daniel H. Bliss (Reg. No. 32,398) [0693.00263]
Bliss McGlynn, P.C.
2075 West Big Beaver Road, Suite 600
Troy, Michigan 48084
(248) 649-6090

Record I.D. 81084721

I hereby certify that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to "Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450" [37 CFR 1.8(a)] on

June 27, 2005
(Date)

Signature of Person Mailing Correspondence

Daniel H. Bliss

Typed or Printed Name of Person Mailing Correspondence

cc:

P30LARGE/REV06

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Art Unit: 2675

Examiner: A. Nelson

Applicant(s): Paul Joseph Stewart et al.

Serial No.: 09/775,368

Filing Date: February 1, 2001

For: SYSTEM AND METHOD OF INTERACTIVE EVALUATION OF A GEOMETRIC MODEL

APPEAL BRIEF

Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

Sir:

By Notice of Appeal filed April 26, 2005, Applicants have appealed the Final Rejection dated January 26, 2005 and submit this brief in support of that appeal.

REAL PARTY IN INTEREST

The real party in interest is the Assignee, Ford Global Technologies, Inc.

RELATED APPEALS AND INTERFERENCES

There are no related appeals or interferences regarding the present application.

CERTIFICATE OF MAILING: (37 C.F.R. 1.8) I hereby certify that this paper (along with any paper referred to as being attached or enclosed) is being deposited with the U.S. Postal Service with sufficient postage as First Class mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450 on June 27, 2005, by Daniel H. Bliss
Daniel H. Bliss

STATUS OF CLAIMS

Claims 1 through 20 have been rejected.

Claims 1 through 20 are being appealed.

STATUS OF AMENDMENTS

An Amendment Under 37 C.F.R. 1.116 was filed on March 24, 2005 in response to the Final Office Action dated January 26, 2005. An Advisory Action dated April 20, 2005, indicated that the request for reconsideration had been considered, but did not deem to place the application in a condition for allowance. There was no indication that the Amendment under 37 C.F.R. 1.116 was entered. A Notice of Appeal, along with the requisite fee, was filed on April 26, 2005. The Appeal Brief, along with the requisite fee, is submitted herewith.

SUMMARY OF THE CLAIMED SUBJECT MATTER

The claimed subject matter is directed to a system of interactive evaluation of a geometric model including a computer system having a memory, a processor, a user input device, and a display device. [A system 10 for interactive evaluation of a geometric model includes a haptic interface 12 operated by a user 14 that controls position, orientation, and force feedback between the user 14, a computer system 16, and a virtual object. The system 10 further includes a computer system 16 operatively connected to the haptic interface 12. The computer system 16 includes a processor, a controller, and a memory to process information relevant to the method of interactive evaluation of a geometric model. The computer system 16 includes a display device 36, such as a video terminal, to display the computer aided vehicle design. The user 14 inputs information into the computer system 16 when prompted to do so. Selection and control of the

information within a screen can be achieved by the user 14 via a user interactive device 38, such as a keyboard.] (FIGS. 1 through 3; Specification, page 7, line 25 through page 8, line 5 and page 10, line 14 through page 11, line 1).

The system also includes a computer generated geometric model stored in the memory of the computer system. [The virtual object is a geometric model representing the design form of a physical model. In this example, the computer generated geometric model represents a design form for a vehicle. The vehicle design is typically generated through the use of conventional computer aided design (CAD), including computer aided manufacturing (CAM) and computer aided engineering (CAE) techniques.] (FIGS. 1 through 3; Specification, page 8, lines 6 through 13).

The system further includes a haptic interface operatively in communication with the computer system. [The system 10 includes a haptic interface 12 operated by a user 14 that controls position, orientation, and force feedback between the user 14, a computer system 16, and a virtual object.] (FIGS. 1 through 3; Specification, page 8, lines 2 through 5).

The haptic interface includes a haptic device for transmitting information between a user and the geometric model. [The haptic interface 12 includes a haptic end effector device 18, such as a stylus, pen, or any other similar gripping device. The haptic end effector device 18 is grasped by the user 14 and translates information regarding a surface of the geometric model, such as sensations of rigidity and facial roughness.] (FIGS. 1 through 3; Specification, page 8, lines 14 through 19).

A haptic device position and orientation are acquired with respect to a surface of the geometric model and mapped into a geometric model coordinate reference system. A closest point position and orientation on the surface of the geometric model to the haptic device position

is determined. A surface property of the geometric model at the closest point position and orientation is extracted. A stick-to-surface force and a property-feedback force are determined and applied to the haptic device to constrain a motion of the haptic device to stick to a virtual surface representing the surface of the geometric model, thereby constraining a hand of a user to always be on the surface to enable the user to explore and feel the geometric model. [In block 145, the methodology computes a force feedback representing a stick-to-surface force, and a property-feedback force. The properties of the surface are tactilely conveyed to the user 14 by constraining the haptic end effector device 18 to the surface 20. In this manner, the user 14 can feel the surface properties. The orientation of the haptic end effector device 18 is used to provide the user 14 with feedback as to what properties are changing on the surface 22 of the model 24. The stick-to-surface force conveys the attraction of the haptic end effector device 18 to the surface 20 of the model 24. Also, the stick-to-surface force maintains the orientation of the haptic end effector device 18 parallel to the normal of the surface 20, and the haptic end effector device 18 in contact with the surface 20. The property-feedback force represents a torque applied to a tip of the haptic end effector device 18, to constrain the orientation of the haptic end effector device 18 to match the selected surface property to the user 14. In block 150, the stick-to-surface force, F_{stick} and property feedback force, F_{sp}, are added together and applied to the haptic end effector device 18. Advantageously, the user's hand 34 is constrained to the virtual surface 20 as he/she browses the surface 20 using the haptic end effector device 18. The user 14 receives tactile and visual stimulation directly from the computer model 24. Geometric properties such as curvature changes, discontinuities, irregularities, smoothness and fairness are conveyed to the user 14, that could previously only be conveyed via a physical prototype.] (FIG. 4; Specification, page 17, line 26 through page 19, line 16).

The claimed subject matter is also directed to a method of interactive evaluation of a geometric model. [A method of interactive evaluation of a geometric model provides the user 14 with tactile and visual information directly from the computer model. The user 14 holds the haptic end effector device 18, and the motion of the haptic end effector device 18 is constrained to the surface 22 of the geometric model 24, and oriented normal to the surface 22. The user 14 can apply the methodology for assessing the smoothness, fairness or other geometric property of the surface 22.] (FIG. 4; Specification, page 13, lines 9 through 17).

The method includes the steps of acquiring a haptic device position and orientation with respect to a surface of the geometric model. The haptic device is operatively connected to a haptic interface and the geometric model is stored in a memory of a computer system. [In block 115, the methodology determines a haptic end effector device position within a haptic end effector device coordinate system reference frame, for use in determining the haptic end effector device position and orientation. The haptic end effector device position $P_{hardware}$ represents the physical position of the haptic end effector device 18, and the orientation of the haptic end effector device 18 is represented by a normal to the surface of the geometric model 24, referred to as $N_{hardware.}$] (FIG. 4; Specification, page 15, lines 4 through 17).

The method also includes the steps of mapping the haptic device position and orientation into a geometric model coordinate reference system. [In block 120, the methodology maps the haptic end effector device position $P_{hardware}$ and orientation $N_{hardware}$ into the geometric model reference system, which in the example is a CAD model. For example, the haptic end effector device position is mathematically derived by multiplying a predetermined factor f_p by the haptic device position $P_{hardware}$ as follows:

$$P_{device} = f_p\,(P_{hardware}).$$

The orientation of the haptic end effector device 18 is similarly mapped into the CAD space using:

$N_{device} = f_N (N_{hardware})$.

P_{device} and N_{device} represent the new position and orientation of the haptic device 18 mapped into the reference system for the CAD model. As illustrated in FIG. 5, the haptic end effector device position P_{device} shown at 50 and orientation N_{device} shown at 52 are mapped into the surface of the CAD model 20.] (FIG. 4; Specification, page 15, line 21 through page 16, line 1).

The method includes the steps of determining a closest point position and orientation on the surface of the geometric model to the haptic device position and extracting a surface property of the geometric model at the closest point position and orientation. [In block 125, the methodology finds a closest point $P_{surface}$ and orientation $N_{surface}$ on the CAD model, to the haptic end effector device position, P_{device}. As illustrated in FIG. 5, $P_{surface}$ and $N_{surface}$ are shown at 54 and 56, respectively. In block 130, the methodology extracts surface properties of the CAD model at the closest point position $P_{surface}$ and orientation $N_{surface}$. An example of a surface property is surface normal $SN_{surface}$, or a curvature value $Sk_{surface}$.] (FIG. 4; Specification, page 16, line 13 through page 17, line 1).

The method further includes the steps of determining a stick-to-surface force and a property feedback force using the surface property at the closet point position and orientation and applying the stick-to-surface force and property feedback force to the haptic device to constrain a motion of the haptic device to stick to a virtual surface representing the surface of the geometric model, thereby constraining a hand of a user to always be on the surface to enable the user to explore and feel the geometric model. [In block 145, the methodology computes a force

feedback representing a stick-to-surface force, and a property-feedback force. The properties of the surface are tactilely conveyed to the user 14 by constraining the haptic end effector device 18 to the surface 20. In this manner, the user 14 can feel the surface properties. The orientation of the haptic end effector device 18 is used to provide the user 14 with feedback as to what properties are changing on the surface 22 of the model 24. The stick-to-surface force conveys the attraction of the haptic end effector device 18 to the surface 20 of the model 24. Also, the stick-to-surface force maintains the orientation of the haptic end effector device 18 parallel to the normal of the surface 20, and the haptic end effector device 18 in contact with the surface 20. The property-feedback force represents a torque applied to a tip of the haptic end effector device 18, to constrain the orientation of the haptic end effector device 18 to match the selected surface property to the user 14. In block 150, the stick-to-surface force, F_{stick} and property feedback force, F_{sp}, are added together and applied to the haptic end effector device 18. Advantageously, the user's hand 34 is constrained to the virtual surface 20 as he/she browses the surface 20 using the haptic end effector device 18. The user 14 receives tactile and visual stimulation directly from the computer model 24. Geometric properties such as curvature changes, discontinuities, irregularities, smoothness and fairness are conveyed to the user 14, that could previously only be conveyed via a physical prototype.] (FIG. 4; Specification, page 17, line 26 through page 19, line 16).

GROUND OF REJECTION TO BE REVIEWED ON APPEAL

The ground of rejection to be reviewed on appeal is whether the claimed invention of claims 1 through 20 is obvious and unpatentable under 35 U.S.C. § 103 over Zilles et al. (U.S. Patent No. 6,111,577).

ARGUMENT

Claims Not Obvious or Unpatentable Under 35 U.S.C. § 103

As to patentability, 35 U.S.C. § 103 provides that a patent may not be obtained:

> If the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Id.

The United States Supreme Court interpreted the standard for 35 U.S.C. § 103 in Graham v. John Deere, 383 U.S. 1, 148 U.S.P.Q. 459 (1966). In Graham, the Court stated that under 35 U.S.C. § 103:

> The scope and content of the prior art are to be determined; differences between the prior art and the claims at issue are to be ascertained; and the level of ordinary skill in the pertinent art resolved. Against this background, the obviousness or non-obviousness of the subject matter is determined. 148 U.S.P.Q. at 467.

Using the standard set forth in Graham, the scope and content of the prior art relied upon by the Examiner will be determined.

As to the primary reference applied by the Examiner, U.S. Patent No. 6,111,577 to Zilles et al. discloses a method and apparatus for determining forces to be applied to a user through a haptic interface. FIG. 15 shows an embodiment of an apparatus for determining forces to be applied to a user through a haptic interface. The apparatus includes a sensor 140, a haptic rendering processor 142 for determining the forces to be applied to the user, a display processor 144, a force actuator 148, and a display 150. The purpose of the sensor 140 is to sense the

position of the user 146. The haptic rendering processor 142 is in electrical communication with the sensor 140 and executes an algorithm to determine the forces to be applied to the user 146 in real space. The algorithm includes a module generating a representation of a real world object in graphic space, a module determining the user's haptic interface in graphic space, a module determining the user's fiducial object in graphic space, and a module calculating a force to be applied to the user in real space. The module determining the user's haptic interface in graphic space translates the position of the user in real space into a position in graphic space. The module determining the user's fiducial object in graphic space determines the location at which the haptic interface would be if the haptic interface could be prevented from penetrating virtual objects. In one embodiment, the user's haptic interface and fiducial object are points in graphic space. In one embodiment, the module calculating a force to be applied to the user in real space calculates a stiffness force to be applied to the user.

In Zilles et al. '577, the display processor 144 is in electrical communication with the haptic rendering processor 142. The display processor 144 displays the representation of the real world object created by the haptic rendering processor 142 on a display 150. In one embodiment, the display processor 144 also displays the user's fiducial object location on the display 150. The user's fiducial object location represents the position of the user in graphic space relative to the virtual object. The force actuator 148 is in electrical communication with the haptic rendering processor 142. The force actuator 148 produces the force calculated by the haptic rendering processor 142 and applies the calculated force to the user 146.

Claims 1 through 3

In contradistinction, the present invention of claim 1 claims the present invention as a system of interactive evaluation of a geometric model including a computer system having a memory, a processor, a user input device, and a display device. The system also includes a computer generated geometric model stored in the memory of the computer system. The system further includes a haptic interface operatively in communication with the computer system. The haptic interface includes a haptic device for transmitting information between a user and the geometric model. A haptic device position and orientation are acquired with respect to a surface of the geometric model and mapped into a geometric model coordinate reference system. A closest point position and orientation on the surface of the geometric model to the haptic device position is determined. A surface property of the geometric model at the closest point position and orientation is extracted. A stick-to-surface force and a property-feedback force are determined and applied to the haptic device to constrain a motion of the haptic device to stick to a virtual surface representing the surface of the geometric model, thereby constraining a hand of a user to always be on the surface to enable the user to explore and feel the geometric model.

The United States Court of Appeals for the Federal Circuit (CAFC) has stated in determining the propriety of a rejection under 35 U.S.C. § 103, it is well settled that the obviousness of an invention cannot be established by combining the teachings of the prior art absent some teaching, suggestion or incentive supporting the combination. <u>See In re Fine,</u> 837 F.2d 1071, 5 U.S.P.Q.2d 1596 (Fed. Cir. 1988); <u>Ashland Oil, Inc. v. Delta Resins & Refractories, Inc.,</u> 776 F.2d 281, 227 U.S.P.Q. 657 (Fed. Cir. 1985); <u>ACS Hospital Systems, Inc. v. Montefiore Hospital,</u> 732 F.2d 1572, 221 U.S.P.Q. 929 (Fed. Cir. 1984). The law followed by our court of review and the Board of Patent Appeals and Interferences is that " [a] <u>prima facie</u> case of

obviousness is established when the teachings from the prior art itself would appear to have suggested the claimed subject matter to a person of ordinary skill in the art." In re Rinehart, 531 F.2d 1048, 1051, 189 U.S.P.Q. 143, 147 (CCPA 1976). See also In re Lalu, 747 F.2d 703, 705, 223 U.S.P.Q. 1257, 1258 (Fed. Cir. 1984) ("In determining whether a case of prima facie obviousness exists, it is necessary to ascertain whether the prior art teachings would appear to be sufficient to one of ordinary skill in the art to suggest making the claimed substitution or other modification.")

As to the differences between the prior art and the claims at issue, the primary reference to Zilles et al. '577 merely discloses a method and apparatus for determining forces to be applied to a user through a haptic interface having a sensor, a haptic rendering processor for determining the forces to be applied to the user, a display processor, a force actuator, and a display. Zilles et al. '577 lacks a stick-to-surface force and a property-feedback force being determined and applied to a haptic device to constrain a motion of the haptic device to stick to a virtual surface representing a surface of a geometric model, thereby constraining a hand of a user to always be on the surface to enable the user to explore and feel the geometric model. In Zilles et al. '577, the haptic device is never locked to the surface, but is free to move in space, and does not constrain a motion of the haptic device to stick to a virtual surface representing the surface of the geometric model.

As to the level of ordinary skill in the pertinent art, in Zilles et al. '577, the stiffness force represents a force that would be applied to a user in a real world by a real world object due to a stiffness of a surface of the object (See Col. 6, lines 49 through 51). However, there is absolutely no teaching of a level of skill in the virtual reality art to include a stick-to-surface force and a property-feedback force that is determined and applied to a haptic device to

constrain a motion of the haptic device to stick to a virtual surface representing a surface of a geometric model, thereby constraining a hand of a user to always be on the surface to enable the user to explore and feel the geometric model. The Examiner may not, because she doubts that the invention is patentable, resort to speculation, unfounded assumptions or hindsight reconstruction to supply deficiencies in the factual basis. See In re Warner, 379 F. 2d 1011, 154 U.S.P.Q. 173 (CCPA 1967).

The Examiner admits on page 3 of the Office Action that Zilles et al. '577 fails to specifically teach generating a stick-to-surface force. However, the Examiner speculates that this step is taught by the application of different surface "feels", as well as the usage of a stiffening force applied on a virtual object surface. Column 6, lines 44 through 68, of Zilles et al. '577 discloses that a stiffness force represents the force that would be applied to the user in the real world by a real world object due to the stiffness of the surface of the object. Contrary to the Examiner's opinion, the feel of the stiffness of the surface does not teach applying a force to a haptic device to constrain a motion of the haptic device to stick to a virtual surface. In this instance, the Examiner has adduced no factual basis to support her position that it would have been obvious to one of ordinary skill in the art to generate a stick-to-surface force, just as any other surface force or "feel", i.e., smoothing, bumps, concaved, solid, or flexible. The Examiner's stated conclusion of obviousness is based on speculation, unfounded assumptions or hindsight reconstruction to supply deficiencies in the factual basis.

Even if Zilles et al. '577 could be modified, it does not teach a system of interactive evaluation of a geometric model including a stick-to-surface force and a property-feedback force being determined and applied to a haptic device to constrain a motion of the haptic device to stick to a virtual surface representing a surface of a geometric model, thereby

constraining a hand of a user to always be on the surface to enable the user to explore and feel the geometric model. The reference, if modifiable, fails to teach or suggest the combination of a system of interactive evaluation of a geometric model including a haptic device for transmitting information between a user and the geometric model wherein a haptic device position and orientation are acquired with respect to a surface of the geometric model and mapped into a geometric model coordinate reference system, a closest point position and orientation on the surface of the geometric model to the haptic device position is determined, a surface property of the geometric model at the closest point position and orientation is extracted, and a stick-to-surface force and a property-feedback force are determined and applied to the haptic device to constrain a motion of the haptic device to stick to a virtual surface representing the surface of the geometric model, thereby constraining a hand of a user to always be on the surface to enable the user to explore and feel the geometric model as claimed by Applicants.

Further, the CAFC has held that "[t]he mere fact that prior art could be so modified would not have made the modification obvious unless the prior art suggested the desirability of the modification". In re Gordon, 733 F.2d 900, 902, 221 U.S.P.Q. 1125, 1127 (Fed. Cir. 1984). The Examiner has failed to show how the prior art suggested the desirability of modification to achieve Applicants' invention. Thus, the Examiner has failed to establish a case of prima facie obviousness.

The present invention sets forth a unique and non-obvious combination of a system of interactive evaluation of a geometric model including a stick-to-surface force and a property-feedback force being determined and applied to a haptic device to constrain a motion of the haptic device to stick to a virtual surface representing a surface of a geometric model, thereby constraining a hand of a user to always be on the surface to enable the user to explore and feel the

geometric model. Advantageously, the system of interactive evaluation of a geometric model constrains a user's motion to stick to a surface of a geometric model within a virtual environment.

Against this background, it is submitted that the present invention of claims 1 through 3 is not obvious in view of a proposed modification of Zilles et al. '577. The reference fails to teach or suggest the combination of the system of interactive evaluation of a geometric model of claims 1 through 3. Therefore, it is respectfully submitted that claims 1 through 3 are not obvious and are allowable over the rejection under 35 U.S.C. § 103.

Claims 4 through 14

As to claim 4, claim 4 claims the present invention as a method of interactive evaluation of a geometric model. The method includes the steps of acquiring a haptic device position and orientation with respect to a surface of the geometric model. The haptic device is operatively connected to a haptic interface and the geometric model is stored in a memory of a computer system. The method also includes the steps of mapping the haptic device position and orientation into a geometric model coordinate reference system. The method includes the steps of determining a closest point position and orientation on the surface of the geometric model to the haptic device position and extracting a surface property of the geometric model at the closest point position and orientation. The method further includes the steps of determining a stick-to-surface force and a property feedback force using the surface property at the closet point position and orientation and applying the stick-to-surface force and property feedback force to the haptic device to constrain a motion of the haptic device to stick to a virtual surface representing the surface of the geometric model, thereby constraining a hand of a user to always be on the surface

to enable the user to explore and feel the geometric model.

As to the differences between the prior art and the claims at issue, the primary reference to Zilles et al. '577 merely discloses a method and apparatus for determining forces to be applied to a user through a haptic interface having a sensor, a haptic rendering processor for determining the forces to be applied to the user, a display processor, a force actuator, and a display. Zilles et al. '577 lacks determining a stick-to-surface force and a property feedback force using a surface property at a closet point position and orientation and applying a stick-to-surface force and property feedback force to a haptic device to constrain a motion of the haptic device to stick to a virtual surface representing the surface of the geometric model, thereby constraining a hand of a user to always be on the surface to enable the user to explore and feel the geometric model. In Zilles et al. '577, the haptic device is never locked to the surface, but is free to move in space, and does not constrain a motion of the haptic device to stick to a virtual surface representing the surface of the geometric model.

There is absolutely no teaching of a level of skill in the virtual reality art to determine a stick-to-surface force and a property feedback force using a surface property at a closet point position and orientation and to apply the stick-to-surface force and property feedback force to a haptic device to constrain a motion of the haptic device to stick to a virtual surface representing a surface of a geometric model, thereby constraining a hand of a user to always be on the surface to enable the user to explore and feel the geometric model. The Examiner may not, because she doubts that the invention is patentable, resort to speculation, unfounded assumptions or hindsight reconstruction to supply deficiencies in the factual basis. See In re Warner, 379 F. 2d 1011, 154 U.S.P.Q. 173 (CCPA 1967).

The Examiner admits on page 3 of the Office Action that Zilles et al. '577 fails to specifically teach generating a stick-to-surface force. Column 6, lines 44 through 68, of Zilles et al. '577 discloses that a stiffness force represents the force that would be applied to the user in the real world by a real world object due to the stiffness of the surface of the object. Where in Zilles et al. '577 does it teach determining a stick-to-surface force and a property feedback force using a surface property at a closet point position and orientation? In Zilles et al. '577, there is no teaching of applying a stick-to-surface force and property feedback force to a haptic device to constrain a motion of the haptic device to stick to a virtual surface. The Examiner has not cited any references that teach this step.

The Zilles et al. '577 algorithm, originally published in 1995 under the title "A Constraint-Based God-Object Method for Haptic Display" is about improving how collisions are rendered with virtual objects to make them "feel real". As such, as stated in Column 4, lines 49 through 58, when the haptic device is not in contact with an object, the fiducial object and haptic device coincide. The fiducial object is the "virtual" location of the haptic interface. The fiducial object location represents the location in graphic space at which the haptic interface would be located if the haptic interface could be prevented from penetrating the virtual objects. The fiducial object does not penetrate the surfaces of virtual objects. When the haptic interface does not penetrate the surface of a virtual object, the haptic object and the fiducial object coincide.

In the present application, the closest point is "always" on the surface, so that the haptic device is not only prevented from penetrating, but also from leaving the surface. Additionally, the haptic device is also constrained to be aligned with the normal to the surface. This is clearly not an obvious way of interacting with "real" virtual objects.

The present invention sets forth a unique and non-obvious combination of a method of interactive evaluation of a geometric model in which the motion of the user is constrained to the virtual surface representing the geometric model, to provide the user with an enhanced understanding of the geometric properties of the model. The reference, if modifiable, fails to teach or suggest the combination of a method of interactive evaluation of a geometric model including the steps of determining a stick-to-surface force and a property feedback force using a surface property at a closet point position and orientation and applying the stick-to-surface force and property feedback force to control a location and force output of a haptic device to constrain a motion of the haptic device to stick to a virtual surface representing the surface of the geometric model, thereby constraining a hand of a user to always be on the surface to enable the user to explore and feel the geometric model as claimed by Applicants.

Against this background, it is submitted that the present invention of claims 4 through 14 is not obvious in view of a proposed modification of Zilles et al. '577. The reference fails to teach or suggest the combination of the method of interactive evaluation of a geometric model of claims 4 through 14. Therefore, it is respectfully submitted that claims 4 through 14 are not obvious and are allowable over the rejection under 35 U.S.C. § 103.

Claims 15 through 20

As to claim 15, claim 15 claims the present invention as a method of interactive evaluation of a geometric model. The method includes the steps of selecting a geometric model from a database in the memory of a computer system and acquiring a haptic device position and orientation with respect to a surface of the geometric model. The haptic device is operatively connected to a haptic interface. The method also includes the steps of mapping the haptic device

position and orientation into a geometric model coordinate reference system and determining a closest point position and orientation on the surface of the geometric model to the haptic device position. The method includes the steps of extracting a surface property at the closest point position and orientation and mapping the surface property of the closest point position and orientation into a vector. The method further includes the steps of mapping the surface property of the closest point position and orientation into the haptic device coordinate reference system, determining a stick-to-surface force and a property feedback force using the surface property of the geometric model at the closet point position and orientation, and adding the stick-to-surface force and property feedback force together to form an applied force and applying the applied force to the haptic device to constrain a motion of the haptic device to stick to a virtual surface representing the surface of the geometric model, thereby constraining a hand of a user to always be on the surface to enable the user to explore and feel the geometric model.

As to the primary reference applied by the Examiner, Zilles et al. '577 merely discloses a method and apparatus for determining forces to be applied to a user through a haptic interface having a sensor, a haptic rendering processor for determining the forces to be applied to the user, a display processor, a force actuator, and a display. Zilles et al. '577 lacks determining a stick-to-surface force and a property feedback force using a surface property of a geometric model at a closet point position and orientation, adding the stick-to-surface force and property feedback force together to form an applied force, and applying the applied force to the haptic device to constrain a motion of the haptic device to stick to a virtual surface representing the surface of the geometric model, thereby constraining a hand of a user to always be on the surface to enable the user to explore and feel the geometric model. In Zilles et al. '577, the haptic device

is never locked to the surface, but is free to move in space, and does not constrain a motion of the haptic device to stick to a virtual surface representing the surface of the geometric model.

There is absolutely no teaching of a level of skill in the virtual reality art to determine a stick-to-surface force and a property feedback force using a surface property of a geometric model at a closet point position and orientation, add the stick-to-surface force and property feedback force together to form an applied force, and apply the applied force to the haptic device to constrain a motion of the haptic device to stick to a virtual surface representing the surface of the geometric model, thereby constraining a hand of a user to always be on the surface to enable the user to explore and feel the geometric model. Column 6, lines 44 through 68, of Zilles et al. '577 discloses that a stiffness force represents the force that would be applied to the user in the real world by a real world object due to the stiffness of the surface of the object. However, the feel of the stiffness of the surface does not teach applying a force to a haptic device to constrain a motion of the haptic device to stick to a virtual surface. It is respectfully submitted that the Zilles et al. '577 reference skirts around, but does not suggest the claimed invention as a whole. The analysis advanced by the Examiner here focuses on the obviousness of substitutions and differences, instead of on the invention, *as a whole*, and is an over-simplification of the difficult determination of obviousness. See Hybritech Inc. v. Monoclonal Antibodies, Inc., 802 F.2d 1367, 1383 (Fed. Cir. 1986).

Even if Zilles et al. '577 could be modified, it does not teach a method of interactive evaluation of a geometric model including determining a stick-to-surface force and a property feedback force using a surface property of a geometric model at a closet point position and orientation, adding the stick-to-surface force and property feedback force together to form an applied force, and applying the applied force to the haptic device to

constrain a motion of the haptic device to stick to a virtual surface representing the surface of the geometric model, thereby constraining a hand of a user to always be on the surface to enable the user to explore and feel the geometric model. The reference, if modifiable, fails to teach or suggest the combination of a method of interactive evaluation of a geometric model including mapping a surface property of a closest point position and orientation into a haptic device coordinate reference system, determining a stick-to-surface force and a property feedback force using the surface property of the geometric model at the closet point position and orientation, and applying the stick-to-surface force and property feedback force to control a location and force output of the haptic device to constrain a motion of the haptic device to stick to a virtual surface representing the surface of the geometric model, thereby constraining a hand of a user to always be on the surface to enable the user to explore and feel the geometric model as claimed by Applicants.

The present invention sets forth a unique and non-obvious combination of a method of interactive evaluation of a geometric model including adding a stick-to-surface force and property feedback force together to form an applied force, and applying the applied force to a haptic device to constrain a motion of the haptic device to stick to a virtual surface of a geometric model. Advantageously, the method constrains the motion of the user to the virtual surface to provide the user with an enhanced understanding of the geometric properties of the geometric model.

Obviousness under § 103 is a legal conclusion based on factual evidence (In re Fine, 837 F.2d 1071, 1073, 5 U.S.P.Q.2d 1596, 1598 (Fed. Cir. 1988), and the subjective opinion of the Examiner as to what is or is not obvious, without evidence in support thereof, does not suffice. Since the Examiner has not provided a sufficient factual basis which is supportive of his

position (see In re Warner, 379 F.2d 1011, 1017, 154 U.S.P.Q. 173, 178 (C.C.P.A. 1967), cert. Denied, 389 U.S. 1057 (1968)), the rejection of claims 15 through 20 is improper.

Against this background, it is submitted that the present invention of claims 15 through 20 is not obvious in view of a proposed modification of Zilles et al. '577. The reference fails to teach or suggest the combination of the method of interactive evaluation of a geometric model of claims 15 through 20. Therefore, it is respectfully submitted that claims 15 through 20 are not obvious and are allowable over the rejection under 35 U.S.C. § 103.

CONCLUSION

In conclusion, it is respectfully submitted that the rejection of claims 1 through 20 is improper and should be reversed.

Respectfully submitted,

By: Daniel H. Bliss
Daniel H. Bliss
Registration No. 32,398

BLISS McGLYNN, P.C.
2075 West Big Beaver Road
Suite 600
Troy, Michigan 48084-3443
(248) 649-6090

Dated: June 27, 2005

Attorney Docket No.: 0693.00263
Ford Disclosure No.: 200-1451

APPENDIX

The claims on appeal are as follows:

1. A system of interactive evaluation of a geometric model comprising:

a computer system including a memory, a processor, a user input device, and a display device;

a computer generated geometric model stored in said memory of said computer system; and

a haptic interface operatively in communication with said computer system, wherein said haptic interface includes a haptic device for transmitting information between a user and the geometric model and wherein a haptic device position and orientation are acquired with respect to a surface of said geometric model and mapped into a geometric model coordinate reference system, a closest point position and orientation on the surface of said geometric model to the haptic device position is determined, a surface property of said geometric model at the closest point position and orientation is extracted, and a stick-to-surface force and a property-feedback force are determined and applied to said haptic device to constrain a motion of said haptic device to stick to a virtual surface representing the surface of said geometric model, thereby constraining a hand of a user to always be on the surface to enable the user to explore and feel the geometric model.

2. A system as set forth in claim 1 including a virtual reality display mechanism operatively in communication with said computer system and said haptic interface, so the user can see the geometric model in a virtual environment.

3. A system as set forth in claim 1 wherein said haptic interface tactilely conveys a surface property of the geometric model to a user through said haptic device and said haptic device is constrained to the surface of the geometric model

4. A method of interactive evaluation of a geometric model, said method comprising the steps of:

acquiring a haptic device position and orientation with respect to a surface of the geometric model, wherein the haptic device is operatively connected to a haptic interface and the geometric model is stored in a memory of a computer system;

mapping the haptic device position and orientation into a geometric model coordinate reference system;

determining a closest point position and orientation on the surface of the geometric model to the haptic device position;

extracting a surface property at the closest point position and orientation;

determining a stick-to-surface force and a property feedback force using the surface property of the geometric model at the closet point position and orientation; and

applying the stick-to-surface force and property feedback force to the haptic device to constrain a motion of the haptic device to stick to a virtual surface representing the surface of the geometric model, thereby constraining a hand of a user to always be on the surface

to enable the user to explore and feel the geometric model.

5. A method as set forth in claim 4 including the step of selecting a geometric model from a database in the memory of the computer system prior to said step of acquiring the haptic device position and orientation, wherein the geometric model is a computer-aided design model.

6. A method as set for in claim 5 including the step of configuring the geometric model as a parametric surface, wherein a point representing the model has a set of coordinates within a predetermined coordinate system.

7. A method as set forth in claim 6 including the step of orienting a haptic device position within a haptic device coordinate system.

8. A method as set forth in claim 4 wherein said step of extracting a surface property includes the step of determining a surface normal at the closest point position and orientation.

9. A method as set forth in claim 4 wherein said step of extracting a surface property includes the step of determining a surface curvature at the closest point position and orientation.

10. A method as set forth in claim 4 including the step of mapping the surface property of the closest point position and orientation into a vector after said step of extracting a surface property.

11. A method as set forth in claim 10 including the step of mapping the surface property of the closest point position and orientation into the haptic device coordinate reference system.

12. A method as set forth in claim 4 wherein said step of applying a stick-to-surface force and a property feedback force includes the step of tactilely conveying a surface property of the geometric model to a user through the haptic device and constraining the haptic device to the surface of the geometric model.

13. A method as set forth in claim 4 wherein the user views the surface of the geometric model using a virtual reality display mechanism in communication with the computer system and the haptic interface.

14. A method as set forth in claim 13 wherein the computer system, haptic interface and virtual reality display mechanism are in communication with each other.

15. A method of interactive evaluation of a geometric model, said method comprising the steps of:

selecting a geometric model from a database in the memory of a computer system;

acquiring a haptic device position and orientation with respect to a surface of the geometric model, wherein the haptic device is operatively connected to a haptic interface;

mapping the haptic device position and orientation into a geometric model coordinate reference system;

determining a closest point position and orientation on the surface of the geometric model to the haptic device position;

extracting a surface property at the closest point position and orientation;

mapping the surface property of the closest point position and orientation into a vector;

mapping the surface property of the closest point position and orientation into the haptic device coordinate reference system;

determining a stick-to-surface force and a property feedback force using the surface property of the geometric model at the closet point position and orientation; and

adding the stick-to-surface force and property feedback force together to form an applied force and applying the applied force to the haptic device to constrain a motion of the haptic device to stick to a virtual surface representing the surface of the geometric model, thereby constraining a hand of a user to always be on the surface to enable the user to explore and feel the geometric model.

16. A method as set forth in claim 15 including the step of configuring the geometric model as a parametric surface, wherein a point representing the model has a set of coordinates within a predetermined coordinate system.

17. A method as set forth in claim 16 including the step of orienting a haptic device position within a haptic device coordinate system.

18. A method as set forth in claim 15 wherein said step of extracting a surface property includes the step of determining a surface normal at the closest point position and orientation.

19. A method as set forth in claim 15 wherein said step of extracting a surface property includes the step of determining a surface curvature at the closest point position and orientation.

20. A method as set forth in claim 15 wherein the user views the surface of the geometric model using a virtual reality display mechanism in communication with the computer system and the haptic interface.